To: CX SXT Team
From: Bill Davis / Bill Podgorski SAO
Date: May 14, 2003
Subject: OAP-2 Thermal Gradient Distortion Mitigation

Thermal gradients in the OAP-2 Titanium housing produce significant performance degradation. This was recognized during the planning stages of the X-Ray tests, and a thermal enclosure was designed and built to minimize the gradients. Thinking ahead toward the flight design, methods to reduce sensitivity to thermal gradients are being investigated.

The errors produced by a "Y" gradient (along a radial line at the segment mid-azimuth) produces an error of 16 arc-sec HPD for a +/- 1°C gradient from the inner to outer surfaces of the OAP-2 housing. This is due primarily to the "hotdogging" of the OAP-2 assembly. In an effort to reduce the sensitivity to this gradient, boundary conditions were applied to the model which represent a 0 CTE connection between the P and H housings connected at their mid-length positions. While this does not reduce the amount of "hotdogging" in each module, it does reduce the relative tips of the P and H modules to each other. The net result is a reduction in the HPD from 16 arc-sec to 11 arc-sec for the same thermal gradient condition. Figure 1 shows the deformed geometry for the OAP-2 with "T-bar" connections, and Figure 2 shows the deformed geometry for the ideal 0-CTE connections.

The HPD for each case varies with aperture width, due to the fact that the deformed shape is not axisymmetric. The HPD variations with aperture are plotted in Figure 3.

X-Ray testing of the OAP-2 will be performed at the MSFC Stray Light Test Facility in a tightly controlled thermal box, so this analysis was performed more as a study for the Flight design than as a design change for the OAP-2.

As the flight design evolves, the benefit of this 0-CTE connection will be weighed against the difficulty of implementation as it relates to thermal performance predictions and error budgets.

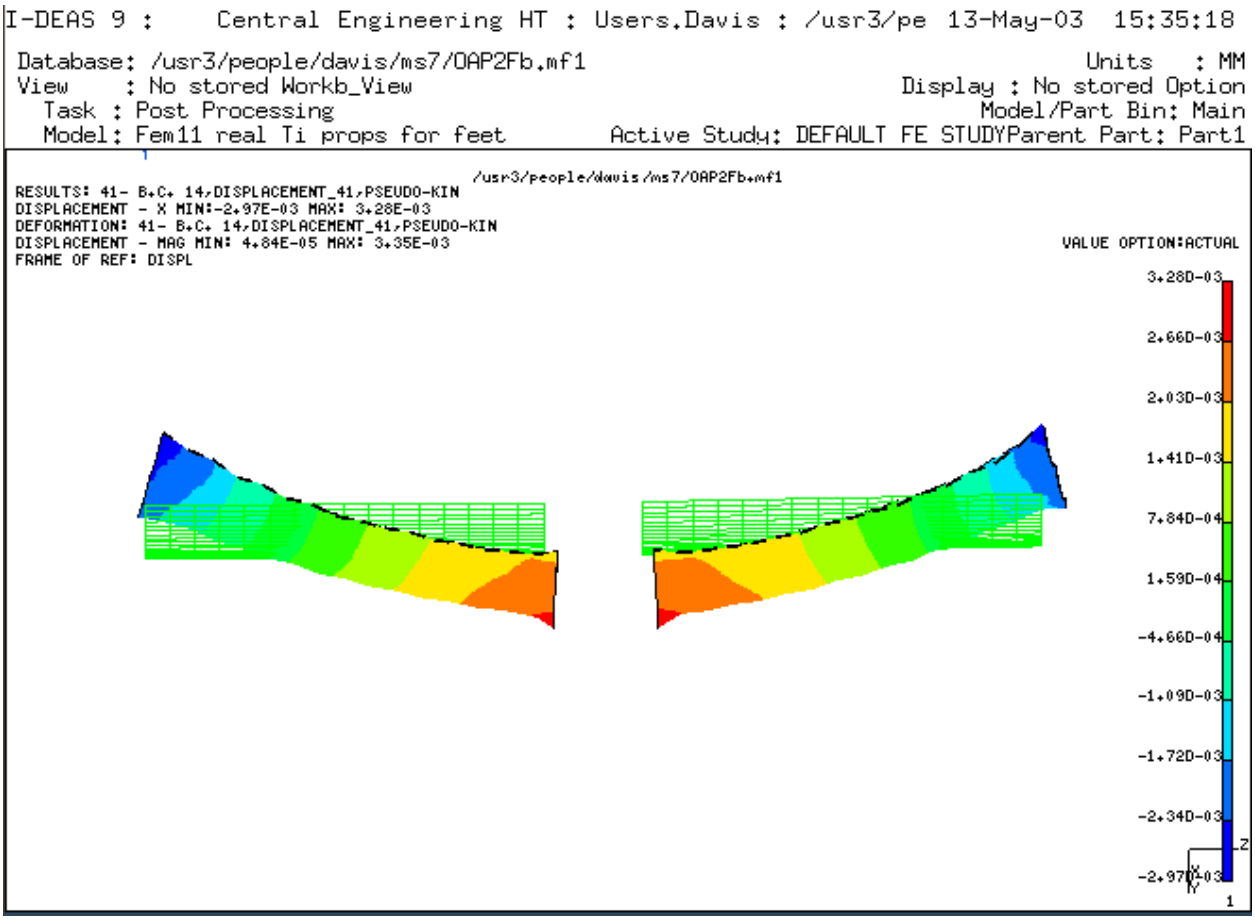

Figure 1 - OAP-2 Y Gradient with Titanium T-Bar Connections

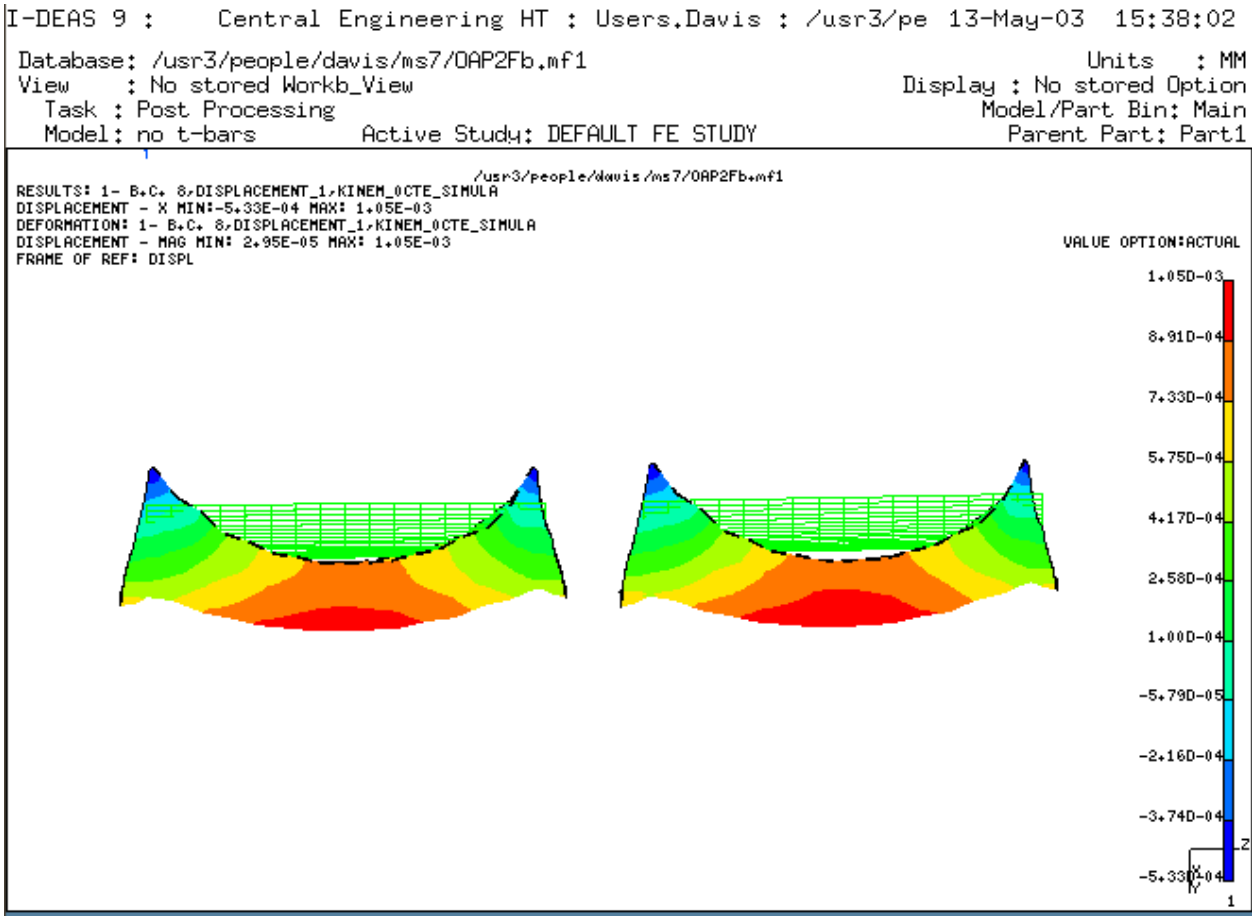

Figure 2 - OAP-2 Y Gradient with Ideal 0-CTE Connections

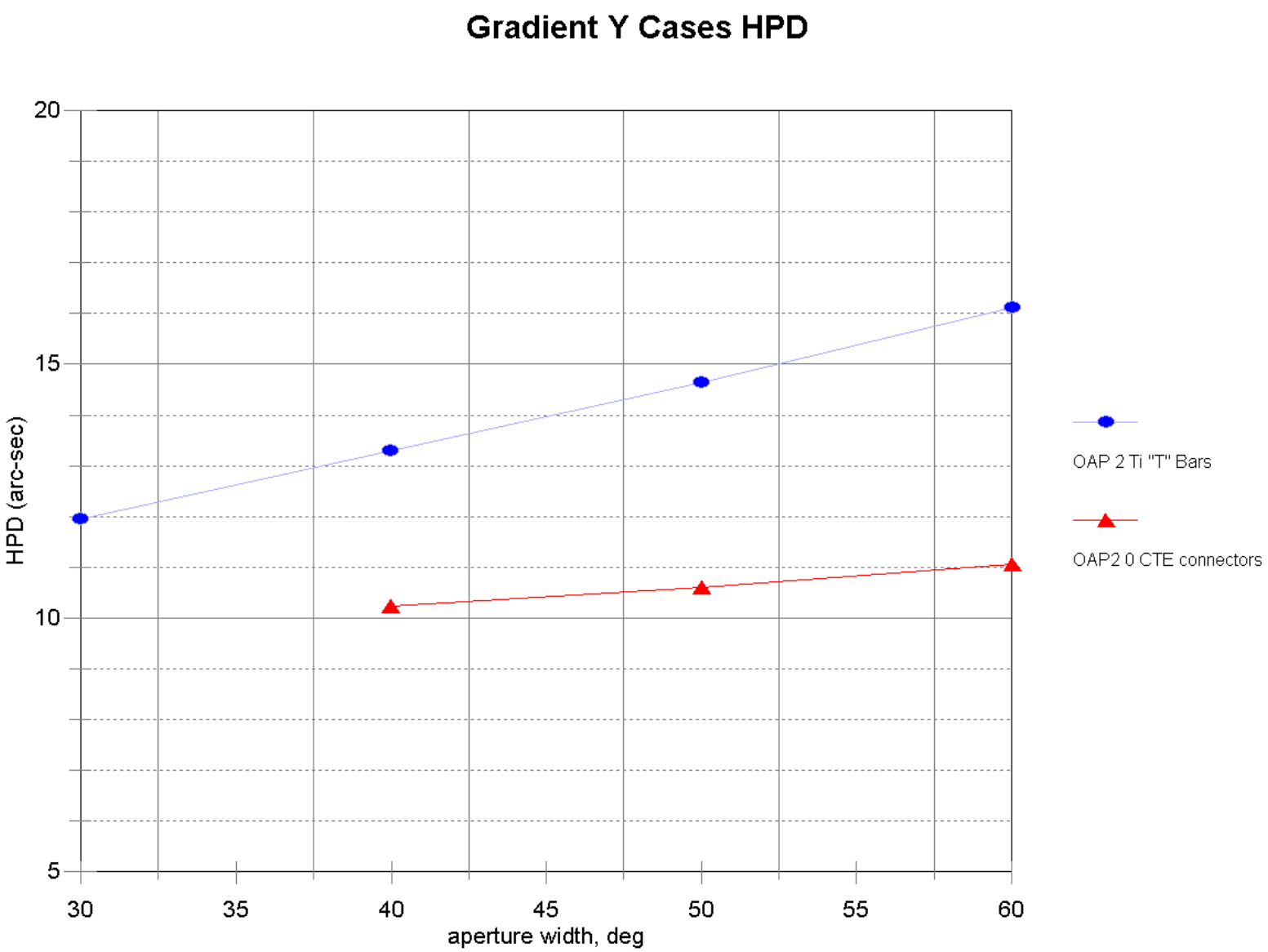

Figure 3 - HPD Variation with Aperture Width